Montana Fish, Wildlife & Parks

MEMORANDUM

To: WPIC CSKT Technical Working Group

From: Andy Brummond

Date: July 1, 2014

Subject: Draft Evaluation of CSKT Instream Flow Levels

Following is a restatement of questions posed by Representatives Ballance and Regier under 1b and 1c of the Water Use Agreement section of the Environmental Analysis portion:

1. Will the instream flow levels listed in the Water Use Agreement, which are generally larger than the present interim instream flow levels, impact fish survival, stream bank stability, erosion and the integrity of irrigation structures?

2. What is the basis for the instream flow levels listed in the Water Use Agreement and are they reasonable?

With respect to the first question, the existing interim instream flow levels are not measurements of the actual flow that now occurs, but rather minimum targets below which flow should not drop. The interim instream flow levels are the same value year round and do not follow the shape of the hydrograph already occurring in these streams. During the higher flow months when ample water is available, these interim levels are already vastly exceeded by actual stream flow.

Increased streamflow resulting from improved management and betterment projects will be very modest in respect to higher instream flows already occurring and would not be expected to significantly change the impacts to stream bank stability, erosion and the integrity of irrigation structures. Rarely do higher flows have a negative impact on the fishery, and even then the short term negative impacts are overshadowed by the long term benefits. Fish are well adapted to tolerating high flows which are important in channel forming function and riparian processes that are critical in providing and maintaining fishery habitat. The modest expected increase in instream flow due to management changes and betterment projects would be expected to only benefit the fishery.

With respect to question two, the basis of the instream flow levels is the water currently left instream plus water added by improved management and betterment projects. Based on the information provide so far to the Technical Working Group it has been established that no specific instream flow methodology has been applied to arrive at these values. However, this

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does not necessarily mean that the Water Use Agreement (WUA) instream flow levels are not representative of the fishery needs.

The ecological integrity of a stream is dependent on the natural flow regime which directly affects the water quality, energy sources, physical habitat and biotic interactions. (Poff, et. al. 1997) The natural flow regime includes the hydrologic timing, magnitude and variability (both intra and inter-annual). Anthropogenic modifications of the natural flow regime can affect water quality, energy sources, physical habitat and biotic interactions which in turn impact the health and integrity of the fishery. The WUA instream flow hydrographs do generally tend to follow the shape of the natural hydrograph with the highest flows occurring in late spring and the lowest flows in late winter, consistent with the natural flow regime paradigm. Additionally, they include recognition of different types of years (i.e. dry, normal, wet) accounting for some level of inter-annual variability. While no specific instream flow methodology has been directly applied, the instream flow hydrographs are generally supported by the recognized instream flow principle of providing intra and inter-annual variability.

In addition the wetted perimeter methodology likely influenced the development of the interim instream flow values. The wetted perimeter results may have been used in a negotiated process which evaluated competing demands resulting in instream flow levels lower than that prescribed by the wetted perimeter methodology. These most likely served as a backdrop particularly in evaluating the WUA instream flow hydrographs in the lower flow months.

Instream flow methodologies can range from complex and data intensive field studies such as Physical Habitat Simulation (PHABSIM) to office based methods relying on existing hydrologic data. In the case at hand limited time and resources prevents the working group of having the luxury of examining the proposed instream flow hydrographs for every stream let alone using a high effort field methodology such as PHABSIM. What is available is the application of an office-based technique to sentinel USGS stream gages located just above FIIP diversions. These sentential gages are located in the watershed where there is little or no anthropogenic influence due to the diversions or introduction of water.

I have chosen 3 of these sentinel gages to develop instream flow values for the purpose of comparing them to the WUA instream flow hydrographs. The office-based instream flow methodology I chose was developed for use in British Columbia (DFO, 2004). It is applicable to all rivers across BC. As the Flathead River is shared between British Columbia and Montana, the methodology's applicability rightfully extends into the Flathead basin of Montana as well.

For the purpose of this memorandum I refer to this method developed in British Columbia as the BC method, although others commonly refer to it as the DFO method. This method relies on existing natural hydrologic data. This data can come either from a sentinel gage or can be synthesized. The methodology develops instream flow values on a monthly time step. In addition it limits the maximum diversion rate or rather it sets the maximum amount that by which the stream or river can be depleted even if the set instream flow level is being met. This helps to preserve the high flows that are important in sediment transport as well as channel form and function.

The excerpt in Figure 1 gives the details of the methodology:

The steps in calculating the proposed flow threshold are as follows:

1. determine fish-bearing status of streams in the impact area,
2. obtain 20 or more years of continuous natural daily flow records (i.e., corrected for existing water uses),
3. calculate the 80th percentile flow over the period of record to set the maximum diversion rate,
4. calculate the median of mean daily flows during each calendar month,
5. order monthly values from step 4 in sequence from lowest to highest,
6. set the flow threshold in the lowest flow month to 90th percentile of mean daily flows in that month,
7. set the flow threshold in the highest flow month to 20th percentile of mean daily flows in that month,
8. set the flow threshold for all other months as a percentile of mean daily flows in that month, where the percentile is calculated according to the formula:

$$90 - \left[\left(\frac{median_i - median_{min}}{median_{max} - median_{min}} \right) \times (90 - 20) \right]$$

where
$median_i$ is the median of mean daily flows for month i,
$median_{min}$ is the month of lowest median flows,
$median_{max}$ is the month of highest median flows.

Using this formula the percentile for each month will vary between 20th and 90th.

Figure 1 – Methodology for calculating instream flow levels. **From: DFO, 2004**

The first stream I chose to analyze was South Crow Creek which has a currently active USGS gage No. 12375900. I applied the BC method to discharge data from water years 1983-2013. The following Figures 2 & 3 shows the results (labeled as BC method) in comparison to the interim, minimum enforceable (MEF), normal and wet year instream flow values. The figures also show the actual flow measured below the Feeder Canal as well as a bankfull value as derived by USGS (USGS, 2004). Figure 3 is the same as Figure 2, except the vertical scale is reduced to better show the difference in the bar heights.

The maximum diversion rate is 27 cfs, the 80th percentile of all daily flow values. Analysis of the discharge data indicates that in May-August, the maximum diversion rate of 27 cfs would limit diversion beyond the monthly instream flow value. For example with a June the instream flow value of 50 cfs, when flow is above 77 cfs, the diversion of water is further limited by the 27 cfs diversion maximum. In order to account for this in the figures, the average of the daily amount that the actual flow exceeds 70 cfs is added to the monthly instream flow valued. In the case of June, 11.6 cfs in added to the instream flow value to more accurately portray the recommended instream flow level. This same approach to dealing with the diversion limit was applied to the subsequent two analyses as well.

In all months except February, the BC method yields a recommended instream flow level higher than the MEF, normal and wet years WUA values for South Crow Creek. For February the BC method is slightly lower than the WUA wet year value. In April, May and July, the BC method prescribes a flow substantially higher than even the WUA wet year value. In comparison to the BC method, the WUA values are reasonable if not too low.

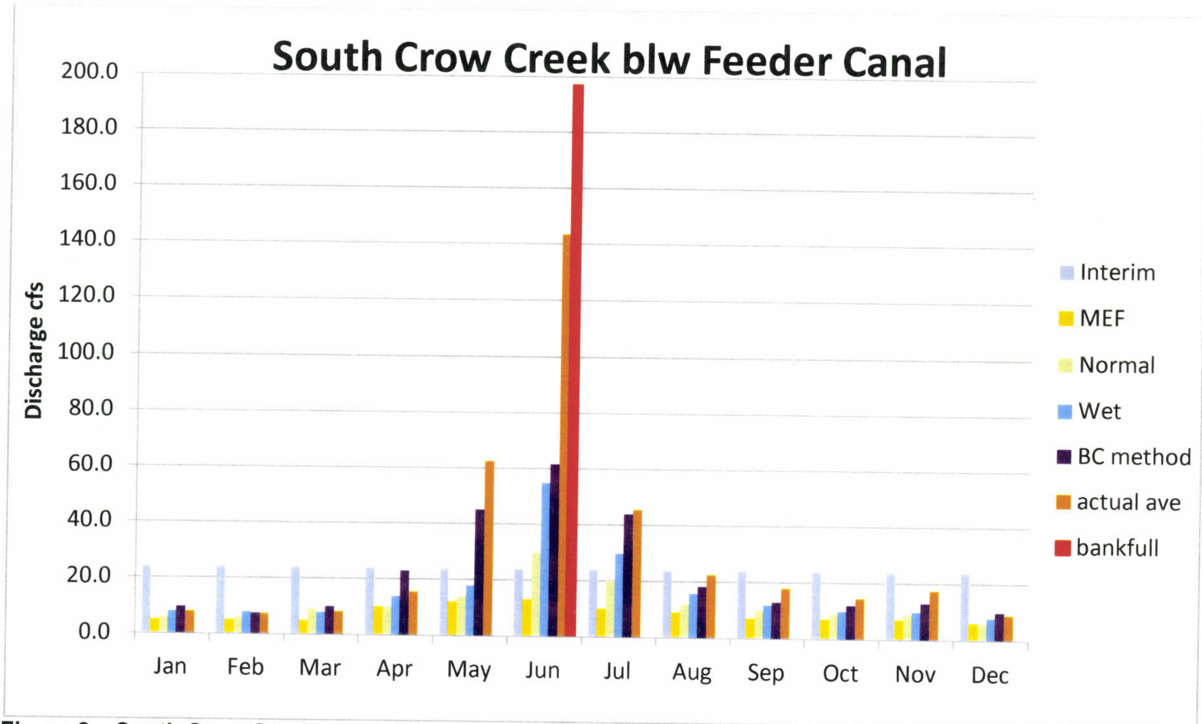

Figure 2 – South Crow Creek comparison of instream flow values – full range

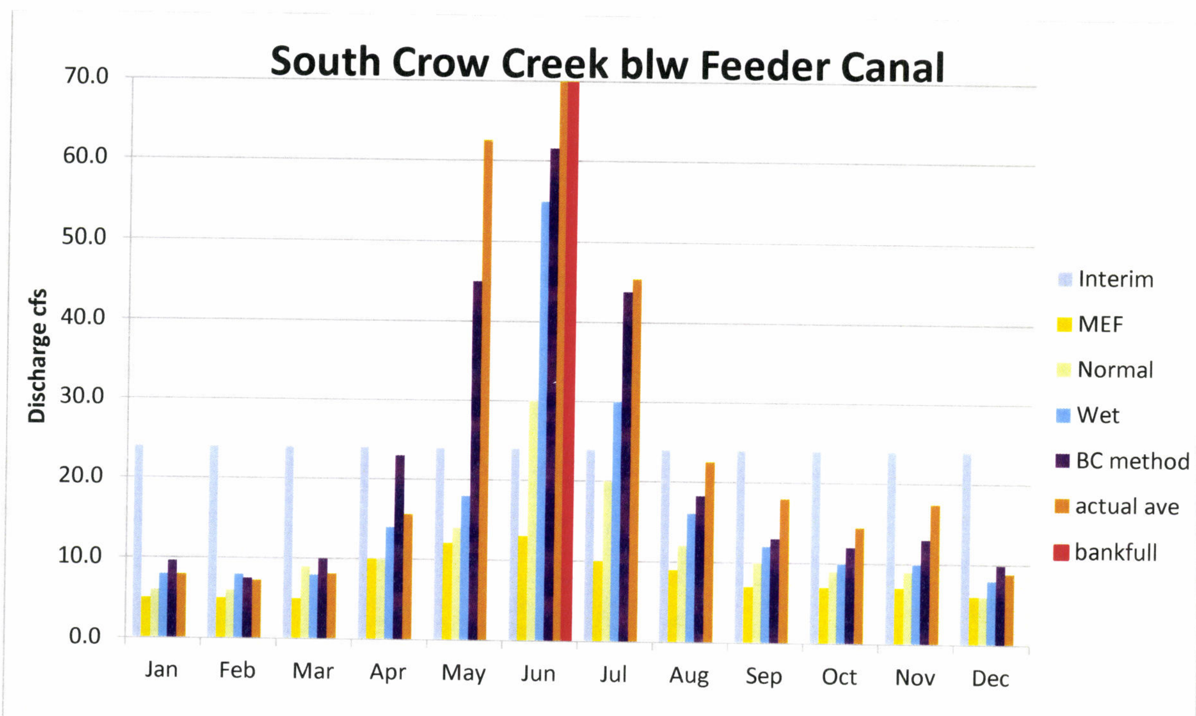

Figure 3 – South Crow Creek comparison of instream flow values –70 cfs max range

In the Technical Working Group meetings the term "robust river standard" has come up. It is clear this means different things to different people. To some it means flows in a river to meet ecosystem needs while to others it seems to mean a bankfull flow at all times. This bankfull definition may be partially the impetus behind restated question no. 1 above. Certainly if the instream flow levels were set to a bankfull level and somehow that amount of water was introduced into the stream at all times, irrigation infrastructure and the riparian and aquatic ecosystem would suffer. The WUA instream flow levels do not approach the 197 cfs bankfull value for South Crow Creek. Only the actual measured instream flow below the Feeder Canal comes close. This flow is unnaturally high due most likely to the transport of water to Kicking Horse Reservoir which is fed from a canal tapping South Crow Creek. The WUA instream flow levels would not in any way threaten the channel integrity of South Crow Creek.

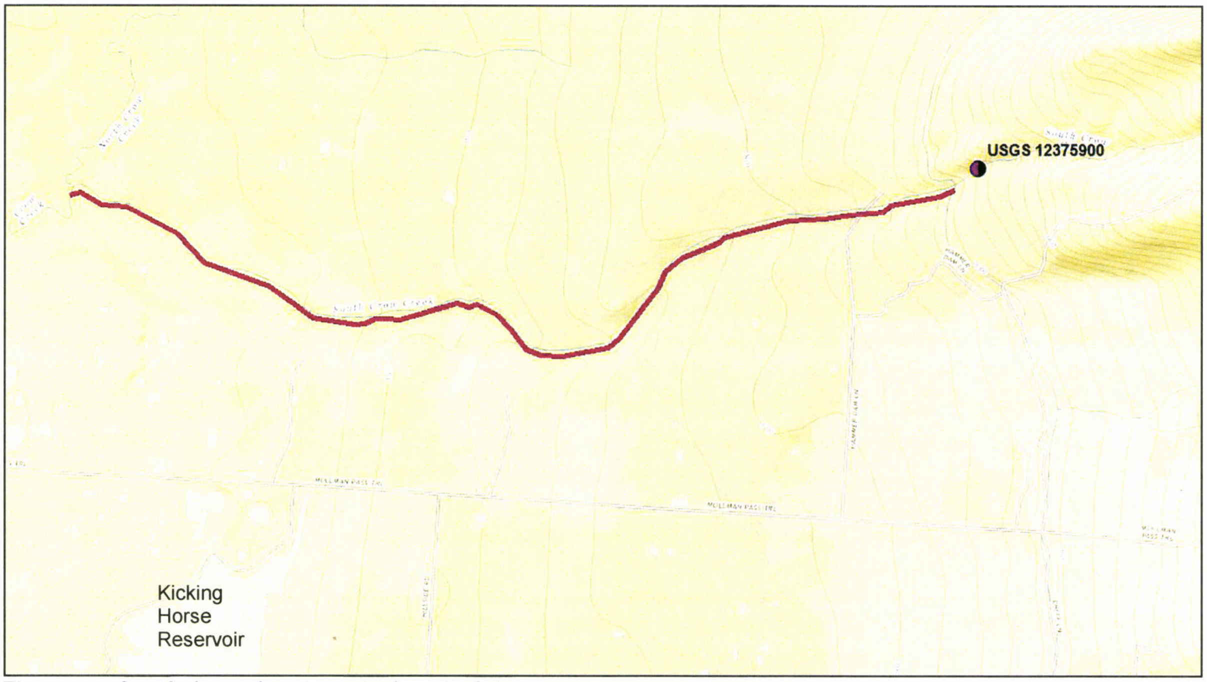

Figure 4 – South Crow Creek area of analysis.

The next stream I chose to analyze was Mission Creek which has a currently active USGS gage No. 12377150 located above Mission Reservoir. In this case I looked at WUA instream flow levels somewhat further downstream on Mission Creek in the reach above Post Creek and below the 6C Canal. The drainage area at this location is considerably larger at this location than at the USGS station, due in large part to the addition of the Dry Creek watershed that is slightly larger than the Mission Creek watershed as measured from the confluence of the two streams. Figure 5 shows the two watersheds as well as the instream flow reach of interest.

For the purposes of this limited analysis I chose to simply double the streamflow values for the Mission USGS gage to estimate the natural streamflow in the reach of Mission Creek immediately downstream of the confluence of Mission and Dry Creeks and above the 6C Canal. This simple approach almost certainly underestimates the actual natural flow, but it reasonable given that most of the water yield is generated higher in the basins with USGS gage 12377150 being located below the highest yielding portions of the Mission watershed.

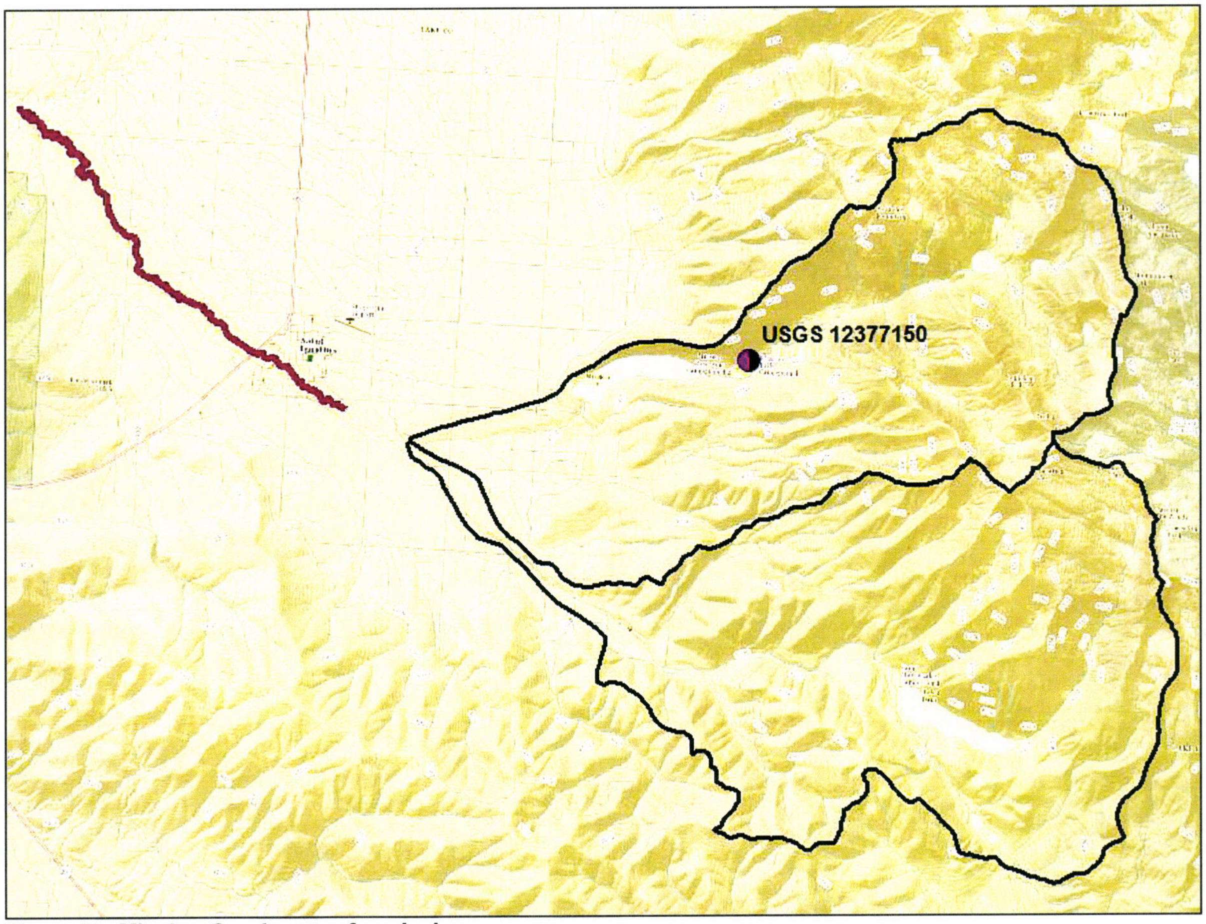

Figure 5 – Mission Creek area of analysis.

I again applied the BC method to discharge data from water years 1983-2013, adjusted to compensate for gage location relative to the study area. The following Figures 6 & 7 shows the results (labeled as BC method) in comparison to the interim, MEF, normal and wet year instream flow values. The figures also show the actual flow measured below the 6C Canal as well as a bankfull value as derived by USGS (USGS, 2004) and doubled to account for the difference in basin size. As before, Figure 6 is the same as Figure 7, except the vertical scale is reduced to better show the difference in the bar heights.

In this situation the BC method yields a recommended instream flow level somewhat lower than the normal and wet years WUA values for this reach of Mission Creek. In a February and March is slightly lower than the MEF as well. This overall result may occur because of the overly simple method of translating the USGS data to a point lower in the watershed yielding artificially low values. With respect to February and March, lower elevation late winter/early spring snowmelt may not be accounted for resulting in the lower February and March BC method values.

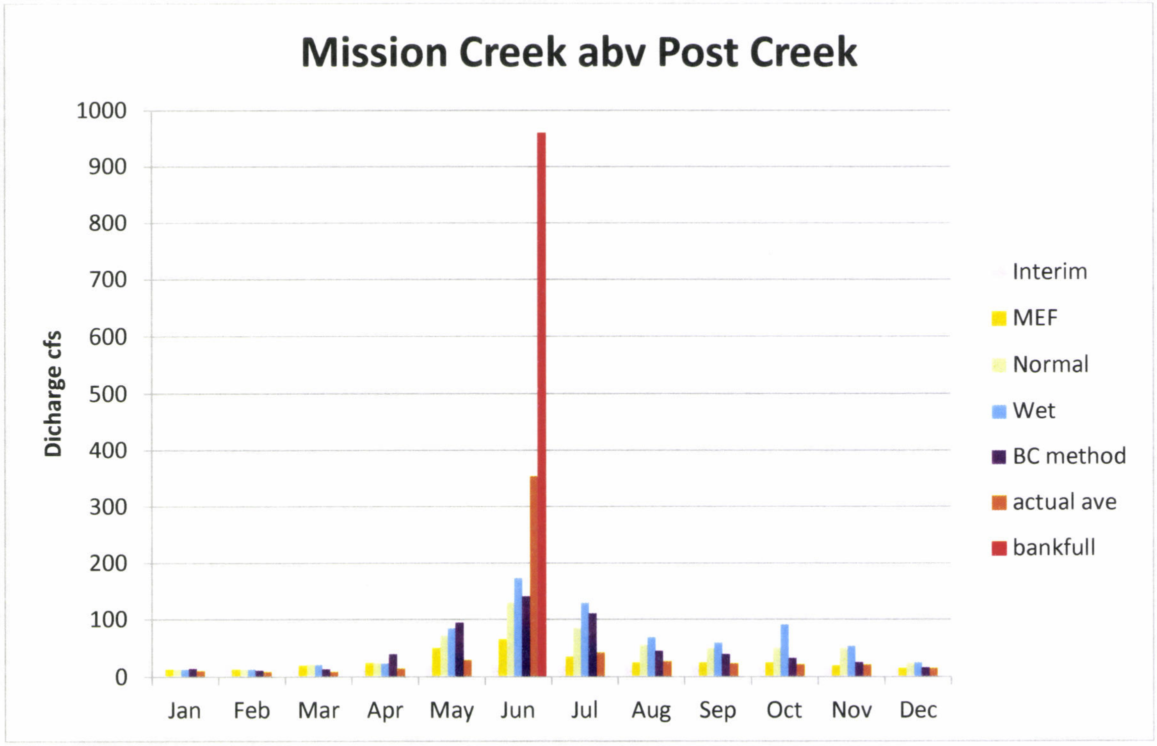

Figure 6 – Mission Creek comparison of instream flow values – full range

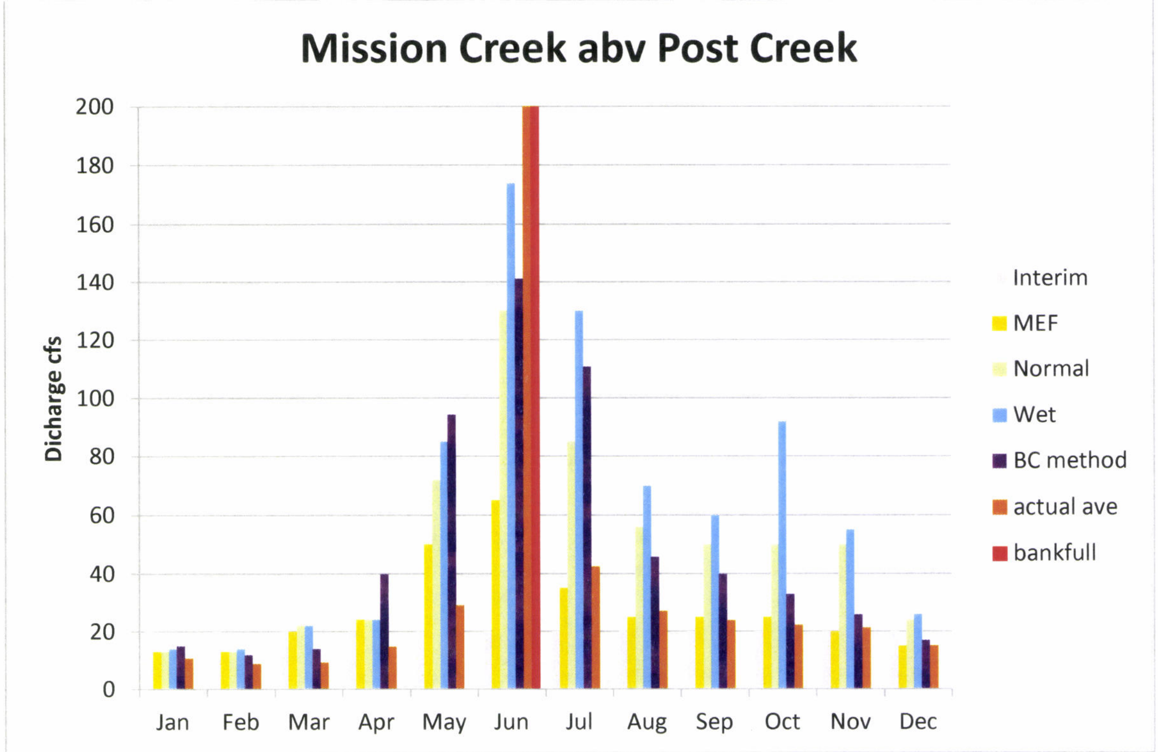

Figure 7 – Mission Creek comparison of instream flow values – 200 cfs max range

I do not have sufficient understanding of the impact of water imported from the Jocko basin as well as stored water to evaluate how these factors may have influenced the development of the WUA instream flow levels. These factors may serve to inflate the later summer and fall instream flow values. Overall the WUA values appear to be in a reasonable range, but on the higher side.

As with South Crow Creek, the bankfull discharge value vastly exceeds the instream flow values. Attaining the instream flow values would not be expected to in any way threaten the channel integrity of Mission Creek.

The final stream I selected for analysis was Big Knife Creek in the Jocko watershed. USGS gage No. 12383500 is located upstream of the Upper Jocko S Canal. This gage is no longer in operation. Figure 8 shows the area on interest.

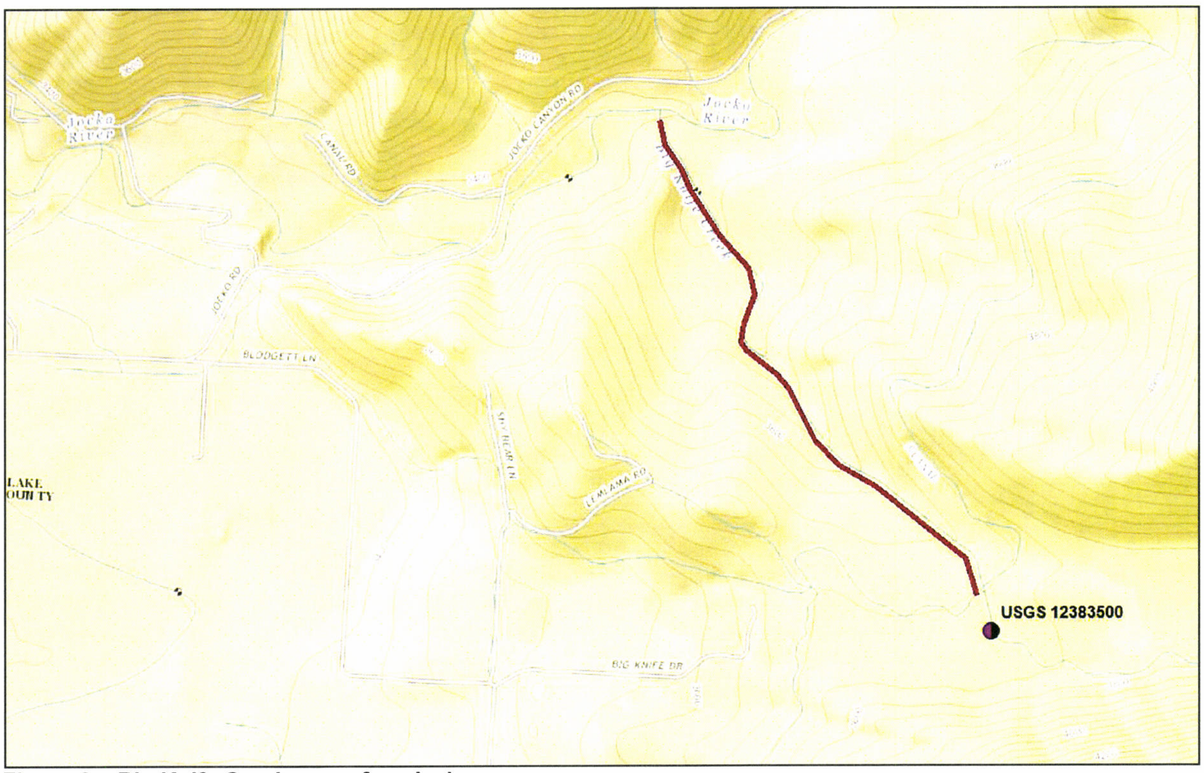

Figure 8 – Big Knife Creek area of analysis

The BC method using discharge data from water years 1983-2010 yielded the values shown in Figure 9. As with the other similar figures, the interim and MEF instream flow values, the bankfull valued calculated by USGS and the actual average flow measured below the Upper Jocko S Canal are displayed as well. Normal and wet year instream flow values are not shown as none have been proposed for this site.

The BC method yields a recommended instream flow level higher than the MEF WUA values for Big Knife Creek in all months. This indicates that the MEF values are low and may not allow Big Knife Creek to attain its full fishery potential.

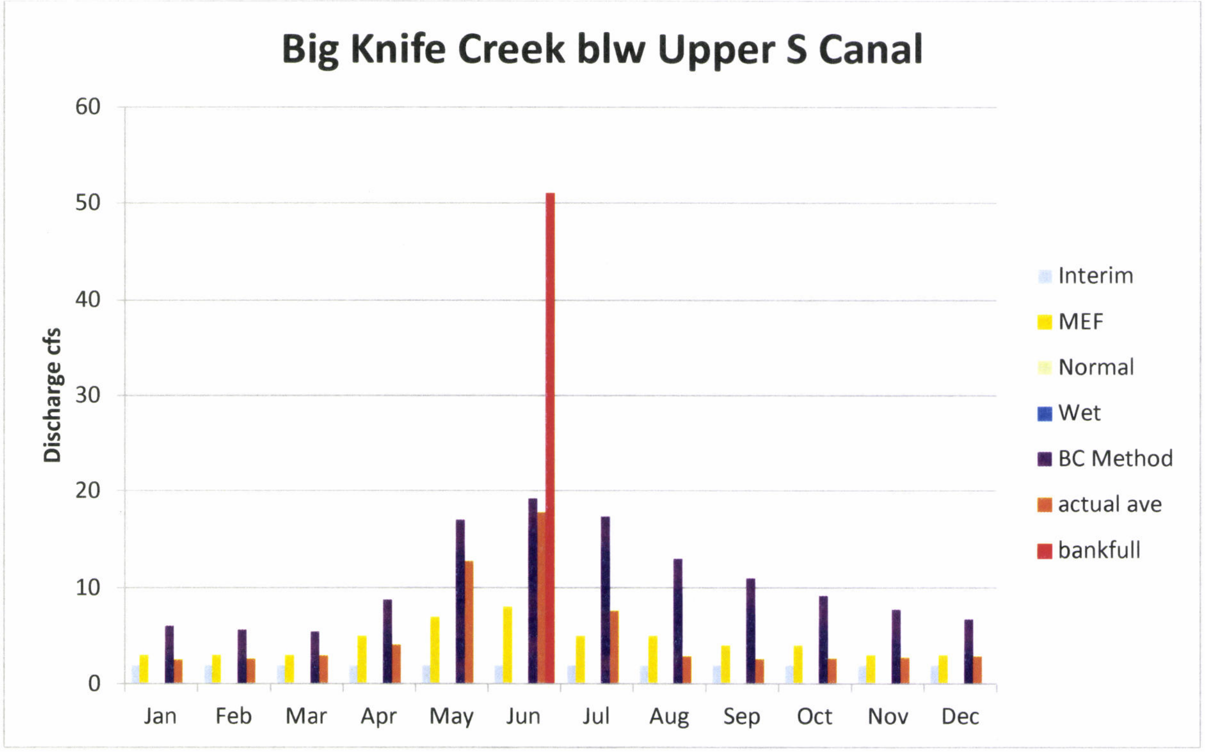

Figure 9 – Big Knife Creek comparison of instream flow values

For Big Knife Creek the bankfull discharge value calculated by USGS vastly exceeds the instream flow values. Attaining the MEF instream flow values would not be expected to in any way threaten the channel integrity of Big Knife Creek. In fact, care should be taken that on occasion Big Knife Creek does reach bankfull flow to assure property stream function.

Conclusions

The analysis of each of three streams yielding a slightly different result demonstrates the complexity of the hydrologic system involved. The three comparisons to the BC method indicated that the WUA instream flow values are reasonable with the greatest divergence being instream flow values being too low for Big Knife Creek.

As a whole a more comprehensive instream flow assessment would likely yield results brining recommended instream flow levels closer to the natural hydrograph. In some areas within the FIIP where significant amounts of water are introduced, this could lead to instream flow values somewhat lower than that which is presently occurring during most times. However, looking as the FIIP as a whole, a more comprehensive instream flow evaluation would most likely lead to more water being left instream and leaving the FIIP and less water available for irrigators overall than if the proposed WUA instream flow values are used.

In all three streams investigated, streamflow already greatly exceeds the WUA instream flow levels at times. Application of the WUA levels would not threaten the channel integrity of the streams investigated. Across the FIIP, the introduction of out of basin water and stored water poses more of a threat than achieving the WUA instream flow levels.

References

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